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MACTEC ENVIRONMENTAL RESTORATION SERVICES, LLC

Spectral Gamma-Ray Borehole
Log Data Report

Log Event B

Borehole # 41-09-39

Borehole Information

Farm : SX	**Tank :** SX-109	**Site Number :** 299-W23-234
N-Coord : 35,319	**W-Coord :** 75,829	**TOC Elevation :** 666.11
Water Level, ft :	**Date Drilled :** 12/10/1996	

Casing Record

Type : Steel-welded	Thickness, in. : 0.375	ID, in. : 12
Top Depth, ft. : 0	Bottom Depth, ft. : 6	
Type : Steel-welded	Thickness, in. : 0.500	ID, in. : 6
Top Depth, ft. : 0	Bottom Depth, ft. : 130	
Type : Threaded Ste	Thickness, in. : 0.313	ID, in. : 4
Top Depth, ft. : 3	Bottom Depth, ft. : 225	

Cement Bottom, ft. : 6 **Cement Top, ft. :** 0

Borehole Notes:

Borehole 41-09-39 was originally drilled in December 1996 to a depth of 130.5 ft with 6-in. casing using a percussion hammer drill. The borehole was deepened from about 130.5 to 225 ft from September 5 to December 19, 1997 using a cable-tool drill.

The borehole is triple-cased from the ground surface to 6 ft, double-cased from 6 to 130.5 ft, and single-cased from 130.5 to 225 ft. The casing thickness below 130.5 ft is 0.50 in. The borehole casing has not been perforated or grouted. The zero reference for all log runs is the ground surface.

The borehole was logged at various depths during borehole drilling to determine if contamination was being carried down during drilling. Logging results indicate that contamination is being carried both up and down the inside of the borehole casing and down the outside of the borehole casing.

Equipment Information

Logging System : 2	**Detector Type :** HPGe	**Detector Efficiency:** 35.0 %
Calibration Date : 04/1997	**Calibration Reference :** GJO-HAN-13	**Logging Procedure :** P-GJPO-1783

Log Run Information

Log Run Number : 1	**Log Run Date :** 09/23/1997	**Logging Engineer:** Alan Pearson
Start Depth, ft.: 139.0	**Counting Time, sec.:**	**L/R :** **Shield :** N
Finish Depth, ft. : 120.5	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** 1

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Log Run Number :	2	**Log Run Date :**	10/13/1997	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	140.0	**Counting Time, sec.:**		**L/R :** **Shield :**	N
Finish Depth, ft. :	115.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	1
Log Run Number :	3	**Log Run Date :**	10/15/1997	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	150.0	**Counting Time, sec.:**		**L/R :** **Shield :**	N
Finish Depth, ft. :	115.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	1
Log Run Number :	4	**Log Run Date :**	10/21/1997	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	157.5	**Counting Time, sec.:**		**L/R :** **Shield :**	N
Finish Depth, ft. :	115.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	1
Log Run Number :	5	**Log Run Date :**	10/28/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	167.5	**Counting Time, sec.:**		**L/R :** L **Shield :**	N
Finish Depth, ft. :	115.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	1
Log Run Number :	6	**Log Run Date :**	11/03/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	171.0	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	132.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	7	**Log Run Date :**	11/03/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	132.0	**Counting Time, sec.:**	100	**L/R :** R **Shield :**	N
Finish Depth, ft. :	130.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	8	**Log Run Date :**	11/03/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	130.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	122.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	9	**Log Run Date :**	11/14/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	180.0	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	148.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

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Log Run Number :	10	**Log Run Date :**	11/21/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	187.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	148.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	11	**Log Run Date :**	12/11/1997	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	199.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	175.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	12	**Log Run Date :**	12/15/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	210.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	190.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	13	**Log Run Date :**	12/19/1997	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	224.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	132.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	14	**Log Run Date :**	12/22/1997	**Logging Engineer:**	J. Meisner
Start Depth, ft.:	209.0	**Counting Time, sec.:**		**L/R :** R **Shield :**	N
Finish Depth, ft. :	100.0	**MSA Interval, ft. :**	.25	**Log Speed, ft/min.:**	1

Analysis Information

Analyst : D.L. Parker

Data Processing Reference : MAC-VZCP 1.7.9 Analysis Date : 12/30/1997

Analysis Notes :

This borehole was logged at various depths during borehole drilling operations. The purpose of the logging was to determine if contamination was being carried down by drilling operations. Logging was completed in 14 logging runs. The first four logging runs (i.e., log runs 1 through 4) were performed using only the total gamma logging mode and the Gamma 2 logging system. The fifth logging run (i.e., log run 5) was performed using only the total gamma logging mode and the Gamma 1 logging system. Log runs 6 through 13 were performed using the spectral gamma logging mode and the Gamma 1 logging system. A neutron moisture logging tool was also run upon completion of the borehole (log run 14). The pre-survey and post-survey field verification spectra, where applicable, met the acceptance criteria established for peak shape and system efficiency. The energy calibration and peak-shape calibration from these spectra were used to establish the peak resolution and channel-to-energy parameters used in processing the spectra acquired during the logging operation. Fine gain adjustments were necessary during some log runs to ensure proper peak identification.

Casing correction factors for a 0.50-in.-thick steel casing were applied during analysis.

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The only man-made radionuclide detected in the extended portion of the borehole was Cs-137. The Cs-137 contamination was detected almost continuously from the top of the borehole extension (130.5 ft) to 214 ft. Isolated detections of Cs-137 occurred at depths of 217, 221.5, and 223.5 ft. The extent of Cs-137 contamination varied between logging runs.

Shape factor analysis was performed. The shape factors provide insights into the distribution of the Cs-137 contamination and into the nature of zones of elevated total count gamma-ray activity not attributable to gamma-emitting radionuclides.

The K-40 background concentrations are fairly constant from 131 to 153 ft. K-40 concentrations decrease at 153.5 ft, decrease again sharply at 155 ft, and increase sharply at 160 ft. A peak in K-40 concentrations occurs from about 179 to 181 ft.

Log Plot Notes:

Separate log plots show the man-made and the naturally occurring radionuclides. Six plots showing man-made radionuclide concentrations at various stages of borehole construction are included to show changes in contaminant concentrations, and two plots showing natural radionuclide concentrations at two stages of borehole construction are included for lithology interpretations. The headings of the plots identify the specific gamma rays used to calculate the concentrations. Uncertainty bars on the plots show the statistical uncertainties for the measurements as 95-percent confidence intervals. Open circles on the plots give the MDL. The MDL of a radionuclide represents the lowest concentration at which positive identification of a gamma-ray peak is statistically defensible.

A combination plot includes the man-made and natural radionuclides and the total gamma derived from the spectral data from the final spectral gamma log run (log run 13).

Four plots are included that present total gamma activities measured from each log run to show the changes in total gamma activities from one log run to the next.

A plot of neutron moisture tool response in gross counts per second is included. The neutron moisture tool response is indicative of moisture content.

A plot of neutron moisture tool response in gross counts per second and naturally occurring radionuclide concentrations in picocuries per gram is included. The plot is annotated to explain changes in moisture content and to identify stratigraphy where appropriate.

Three plots of the results of the shape factor analysis for the distribution of gamma-ray energies for this borehole are included for three stages of borehole construction.

A plot showing total gamma activity and end-of-day drilling depths is included. This plot correlates peaks detected in total gamma-ray activity with drilling activities.